REMARKS

In the Office Communication of Nov. 5, 2002, the Examiner stated that the Applicant has failed to provide a drawing and/or amend the drawings to show the following features of the claims: substrate, the laser, the optical detector, the optical amplifier, the optical attenuator.

Changes to Specification:

Minimal changes have been made to the specification to add numeric reference numbers to labels such as "top mirror" to the description of the structures shown in Figures 9 and 10. All changes made are based entirely on the descriptions of the earlier Figures, and thus no new matter has been added.

Changes to Drawings

Revised drawings are attached in Exhibit B. No new matter has been added.

Figure 7A

Support for the labels added to Figure 7A is found in the specification at page 11, line 30 through page 12, line 2:

> Figure 7A is a top view of an alternate embodiment of the invention, which includes a second set of contacts 60A-60B. The second set of contacts allow the device to be operate as a tunable vertical-cavity surface emitting laser (VCSEL) or a tunable detector.

Figure 9.

The numerical labels added to Figure 9 are based entirely on labels in the other Figures. The descriptive label "Top Mirror" added to Figure 9 is based on the terms used in the specification to describe item 32.

The descriptive labels "Laser, Optical Amplifier, Optical Attenuator" added to Figure 9 are based on the following text, found in the specification starting on page 15, line 15 (emphasis added):

> Those skilled in the art will recognize a variety of modifications to the disclosed structure and processes that are within the scope of the invention. For example, the wafer of **Figure 9** may be modified to include a Lambda cavity above the first DBR pair that is on top of the GaAs substrate. Within the Lambda cavity is an active layer. On top of the Lambda cavity is an oxidation layer. An additional DBR pair is then positioned on the oxidation

layer. The three DBR pairs are doped to provide an N-P-N or P-N-P structure. **This configuration is used to form a laser**. Previously cited U.S. Patent 6,026,108 describes structures that may be utilized in accordance with the invention. A P-N junction may also be formed under the mirror head 32 to operate the device as an optical detector. Similar structural modifications may be utilized to **operate the structure of the invention as an optical amplifier and an optical attenuator.**

The descriptive label "Filter" added to Figure 9 is based on the following text, found in the specification starting on page 14, line 21 (emphasis added):

> The invention has been implemented with alternate wafer designs. The first design is a high-quality **filter** with DBR mirrors and narrow linewidth. The second is a simple three-layer structure with a large gap and low-finesse filtering characteristics. **Figure 9** illustrates a high-finesse cavity, MBE-grown wafer that may be processed to form the structure of the invention.

Figure 10.

The numerical labels added to Figure 9 are based entirely on labels in the other Figures. The descriptive labels "Top Mirror" and"Bottom Mirror" added to Figure 10 are based on the terms used in the specification to describe items 32 and 52.

Claim Terms

Substrate

Figures 1, 2 and 3 are plan views of the cantilever structure, with substrate 23 being located below all the other structures shown in these figures. The other structures in these figures are attached to a torsional beam 24 that holds them above the substrate 23.

Figure 6C, a cross sectional view, provides perhaps the best view of the substrate 23 in conjunction with the torsional beam 24. Contact regions 22 are above the torsional beam 24, but the other portions of the structures shown in Figures 1, 2 and 3 are primarily in the plane of the torsional beam 24.

The substrate element of the claims is shown as element 23 in Figures 6A-6D, as well as being in the plane below the structures shown in Figures 1, 2 and 3.

The substrate element of the claims is also shown in Figures 9 and 10 as the bottom GaAs layer of those Figures.

Laser, Optical Attenuator, Optical Detector, Filter

These terms are used in the specification to describe the structures shown in Figures 7A and 9, and these labels have now been added to those Figures. More generally, it is noted here that it is well know that a device having a Fabry-Perot cavity can be operated as a laser, optical attenuator, optical detector or optical filter, so long as the size of the cavity has a proper relationship with the wavelength of the light being generated, detected, attenuated or filtered. Also, in Fabry-Perot cavity structures, the top and bottom mirrors are typically DBR mirrors, of the type shown in Figures 9 and 10 of this application. A primary feature of the present invention is an improved cantilever structure for controlling the size of the cavity (sometimes called the gap or the air gap) in a Fabry-Perot cavity.

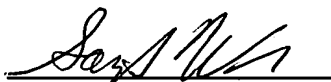
In summary, Applicants respectfully submit that the drawings show all claimed structures and features.

CONCLUSION

In light of the above amendments and remarks, the Applicants respectfully request that the Examiner reconsider this application with a view towards allowance. The Examiner is invited to call the undersigned attorney if a telephone call could help resolve any remaining items.

Respectfully submitted,

Date: December 6, 2002



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Appendix A

Marked-up Version of Changes to Specification

Revise the paragraph beginning at Page 14, Line 21, as follows:

The invention has been implemented with alternate wafer designs. The first design is a high-quality filter with DBR mirrors and narrow linewidth. The second is a simple three-layer structure with a large gap and low-finesse filtering characteristics. Figure 9 illustrates a high-finesse cavity, MBE-grown wafer that may be processed to form the structure of the invention. The designed center filter wavelength is 950 nm. The wafer was grown using Molecular Beam Epitaxy (MBE) using Be for p-doping and Si for n-doping. It is grown on an n-type GaAs substrate. It is composed of 12 pairs of n-doped 1/4 wavelength thick AlAs/GaAs layers followed by one AlAs/$Al_{0.2}Ga_{0.8}As$ layer pair to form the bottom mirror 52. Directly above this was grown an undoped 0.8 μm thick GaAs layer 54, which is to be etched away to form the air gap 64 (see also Figure 7C). The top DBR is composed of 18.5 pairs of 1/4 wavelength thick p-doped $Al_{0.2}Ga_{0.8}As/Al_{0.7}Ga_{0.3}As$ layers, followed by a ½ wavelength thick layer of p-doped $Al_{0.7}Ga_{0.3}As$. The top layer is a 1/4 μm thick p-doped layer of $Al_{0.2}Ga_{0.8}As$. This layer was included to add stiffness to the mechanical structure and is referred to as the stiffening layer. The n-doping and p-doping were set at $1e18cm^{-3}$, with the exception of the top 0.1 μm of the stiffening layer, which was doped $1e19cm^{-3}$ to decrease contact resistance.

Revise the paragraph beginning at Page 15, Line 5, as follows:

Figure 10 illustrates a low-finesse cavity, MOCVD-grown wafer that may be used to fabricate the structure of the invention. The wafer of Figure 10 is designed to be measured at wavelengths in the range of 915nm to 950 nm, with a nominal wavelength of 915 nm. The wafer was grown using Metal-Organic Chemical Vapor Deposition (MOCVD) on an n-type GaAs substrate. The first epitaxial layer is a 6/2 wavelength thick $Al_{0.53}Ga_{0.47}As$ layer n-doped at $1e18cm^{-3}$ forming bottom mirror 52. On top of this is the top mirror 32, a first portion of which is undoped GaAs sacrificial layer 54 with a thickness of 1.36 μm. Next is a

29/4 wavelength thick $Al_{0.53}Ga_{0.47}As$ layer. The upper half of this layer is doped p-type at $1e18cm^{-3}$, while the bottom half is undoped. On the top of the structure is a ½ wavelength thick GaAs cap layer doped at $1e19cm^{-3}$ to lower contact resistance.

Appendix B

Marked-up Version of Changes to Drawings

Revised Figures 7A, 9 and 10 are attached.